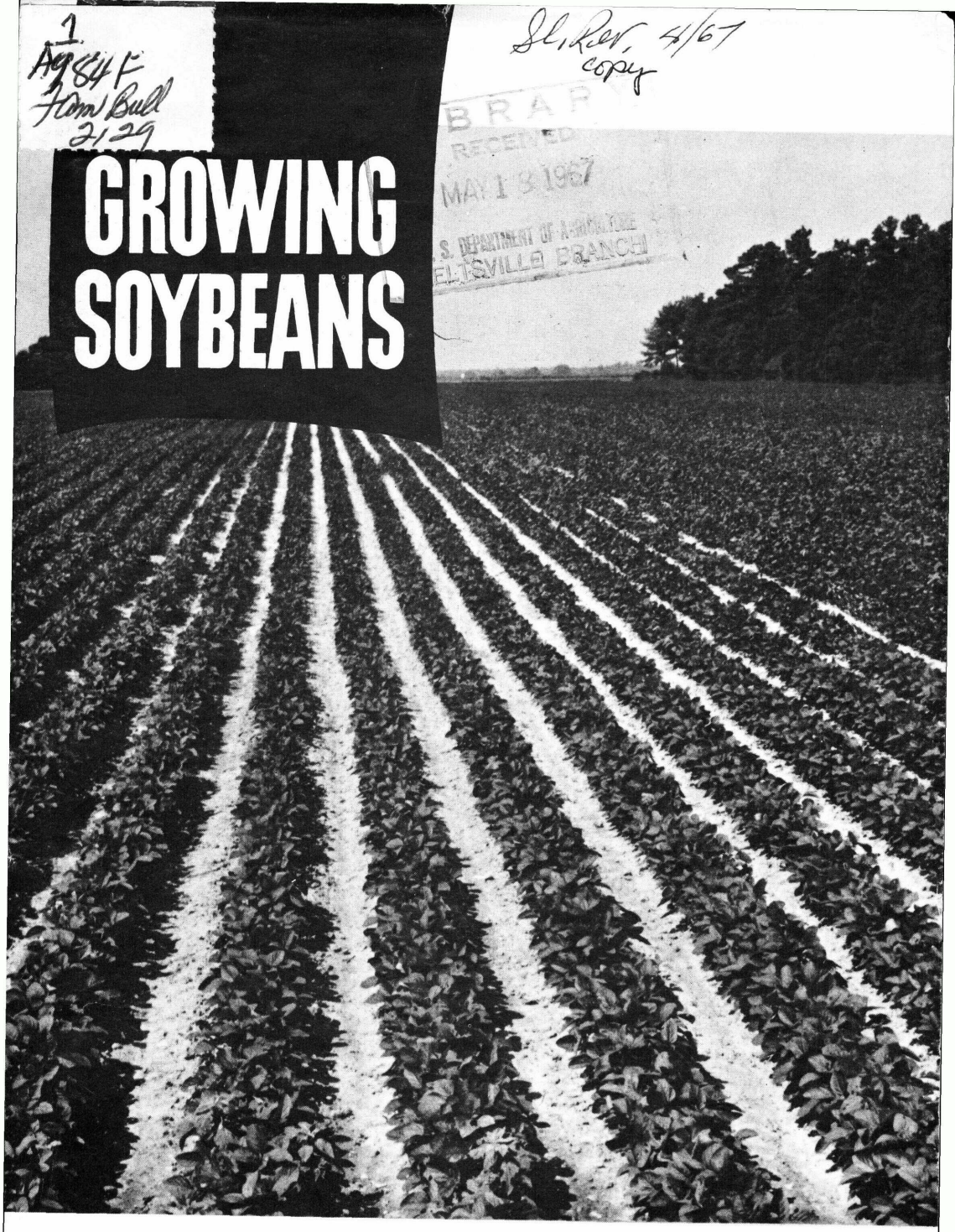
GROWING SOYBEANS



Farmers' Bulletin No. 2129

U. S. DEPARTMENT OF AGRICULTURE

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Recommendations for growing soybeans vary greatly from State to State and even from county to county. Those given in this bulletin are intended as a general guide. The grower should supplement them with the more detailed recommendations of his State agricultural experiment station and his county agricultural agent.

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GROWING SOYBEANS

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Soybeans rank first among cash crops in the United States. In 1966 approximately 37 million acres were harvested for beans. About 65 percent of the acreage is in Illinois, Iowa, Minnesota, Missouri, Indiana, and Ohio. Arkansas, Mississippi, South Carolina, and North Carolina lead in soybean production in the South, with about 19 percent of the acreage.

USES

Soybeans are grown chiefly for their seeds, or beans, which are used in producing oil and meal.

Of the meal consumed in the United States, more than 95 percent goes into livestock and poultry feeds, but a small part is used for food and industrial products. About 85 percent of the oil consumed in the United States is used in human foods—primarily shortening and margarine. Manufacturers of paints, varnishes, and other industrial products use the remainder.

Soybeans are grown on a small scale for silage and hay, for plowing under as green manure, and as a vegetable.

SOILS

Soybeans grow best on fertile, well-drained soils, but they are tolerant of a wide range of soil conditions. They grow better than many other crops on soils that are low in fertility, droughty, or poorly drained.

Rotations

Soybeans fit well into many systems of crop rotation. Their place in the rotation varies with the type of farming and the locality.

A common rotation in the Corn Belt is corn (one or more years), soybeans, small grain, legumes.

In the South, soybeans are commonly used in a rotation with cotton, corn, or rice. Sometimes they are planted after early potatoes and vegetables and after winter grain. Winter grain is often planted following soybeans in some North Central and Southern States.

Soybeans frequently serve as a "catch crop" in rotations when seedings of grass, clover, or row crops have failed.

Soybeans do well after soybeans, but successive crops on the same land increase the buildup of some disease organisms in the soil.

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Light disking the seedbed prior to planting soybeans.

Seedbed

Seedbed preparation for soybeans is similar to that for corn or cotton. Fall or early spring plowing is preferred by most growers to plowing immediately before planting. It is extremely important that weeds be destroyed by light disking, thorough harrowing, or by use of cultivators, immediately preceding planting. This prevents weeds from getting ahead of soybeans and facilitates weed control.

Fertilizers

Fertilizer needs vary with the soil and the cropping system. Soil tests supply the most accurate information for specific areas.

Fertilizer often is applied to other crops in the rotation and soybeans may not need additional fertilizer. On soils of low fertility, however, fertilizers increase yields. If the plants are nodulated properly, nitrogen fertilizer is not needed.

Fertilizer containing potash is injurious to germination when in direct contact with the seed. Fertilizer may be applied in bands 2 to 3 inches to the side and 2 inches below the seed; or soil and fertilizer may be mixed if an inch of fertilizer-free soil is left between fertilizer and seed. Broadcast fertilizer should be plowed under or disked into the soil.

Lime

Soybeans are more acid tolerant than many legumes but will respond to lime applications on acid soils. A pH level of 6.0 to 6.5 is best in most States. The amount of lime needed to bring pH to the proper level may be determined by soil test. On some soils having a pH of 5.4 to 5.6 addition of 0.2 pound molybdenum per acre will greatly increase seed yields.

VARIETIES

The farmer who is to get full returns for good management must select a productive, well-adapted soybean variety. Seed should be pure and high in germination to prevent incomplete stands and mixture of varieties in the field.

Soybean varieties differ in the time required to reach maturity.

For convenience, they have been divided into 10 maturity groups, OO through VIII.

Length of days and nights is the primary control of soybean flowering and maturity. Since length of day is governed by latitude, soybean varieties are adapted to rather narrow belts running east and west. Group OO varieties bloom and develop seed during long summer days in southern Manitoba, northern Minnesota, and areas of similar latitude. Varieties in groups with higher numbers are adapted to progressively more southern latitudes. Group VIII varieties mature in the Gulf Coast region. The average maturities for the 10 groups and the leading varieties in each group are given in table 1.

The same maturity date for different groups does not indicate that areas of adaptation are the same. If varieties of a group are grown south of their recommended area, they mature earlier. For example, the average maturity of Mandarin (Ottawa) is October 1 when grown in the recommended area for group O, but September 24 when grown in the area of group I. Thus, varieties of group I are not adapted in the group II area even though the average maturity date of the two groups is practically the same.

Varieties can always be grown south of their area of adaptation but they usually yield less, since they mature before the end of the growing season. If they are grown too far north of where they are adapted as full-season varieties, frost probably will damage them.

In the long growing season of the Southern States, varieties have a wider north-south range of adaptation than in the North. As the length of growing season is increased, there is less reduction in yield of varieties that do not utilize the full season. In some areas of the South, group V varieties produce maximum yields even though full-season varieties of the area are of group VI or VII maturity.

Under some conditions, the advantages of planting an early variety may more than offset the loss in yield and quality. Farmers frequently plant an early variety when soybeans are to be followed by the

TABLE 1.—*The maturity, or combining, date of the 10 soybean variety groups when they are grown in their areas of adaptation*

Group	Maturity date (average for group)	Days from planting	Leading varieties—in order of earliness within a group
OO	Sept. 12	117	Portage, Merit, Flambeau.
O	Sept. 20	124	Grant, Mandarin (Ottawa).
I	Sept. 18	124	Chippewa, Chippewa 64, Blackhawk, A–100.
II	Sept. 19	126	Harosoy, Harosoy 63, Lindarin, Lindarin 63, Amsoy, Hawkeye, Hawkeye 63.
III	Sept. 22	128	Adams, Ford, Shelby, Wayne.
IV	Sept. 29	134	Clark, Clark 63, Kent, Bethel, Scott, Delmar.
V	Oct. 7	136	Hill, Dorman, Dare.
VI	Oct. 22	148	Hood, Davis, Lee, Pickett.
VII	Oct. 30	156	Semmes, Bragg, Jackson.
VIII	Nov. 9	158	Hampton, Bienville, Hardee.

seeding of a winter crop. In some areas frequent fall rains cause difficulty in combining full-season varieties, but early varieties mature under favorable harvesting conditions. If the acreage is large, the planting of an early variety on a part of it will lengthen the harvesting period and permit greater use of combining equipment.

SEED TREATMENT

Chemical seed treatments protect the seed from soil-borne diseases. They generally result in improved stands, especially if low-germinating seeds are used.

Seed treatment is not a substitute for good seed. It does not increase yields in proportion to the increase in stand.

Seed can be treated any time before planting—even in the preceding fall at harvest. Chemical treatment reduces effectiveness of inoculation, but treated seed can be inoculated successfully. It does not reduce effectiveness of nitrogen-fixing bacteria already in the soil.

INOCULATION

Soybeans need inoculation with a commercial culture of nitrogen-fixing bacteria unless the bacteria are known to be in the soil. Soybean bacteria live in the soil a number of years. Some farmers do not inoculate if a nodulated crop of soybeans has been grown on the field in the past 4 or 5 years. Others inoculate even though soy-

TABLE 2.—*Planting dates for soybeans in major producing States*

States	Maturity classification of varieties grown	For best results, plant on—	Do not plant later than—
Alabama	VI, VII, VIII	May 10 to June 15	July 10
Arkansas	V, VI, VII	May 1 to 20	June 30
Delaware	III, IV, V, VI	May 10 to 30	June 30
Florida	VI, VII, VIII	June 1 to 30	July 15
Georgia	VI, VII, VIII	May 1 to June 15	July 10
Illinois	I, II, III, IV	May 5 to 25	June 30
Indiana	I, II, III, IV	May 5 to 25	June 30
Iowa	I, II, III	May 1 to 30	June 30
Kansas	III, IV, V	May 10 to June 15	June 30
Kentucky	IV, V, VI	May 1 to 30	June 30
Louisiana	VI, VII, VIII	May 10 to June 15	July 10
Maryland	IV, V, VI	May 15 to 30	June 30
Michigan	O, I, II	May 5 to 30	June 30
Minnesota	OO, O, I, II	May 10 to 30	June 30
Mississippi	V, VI, VII	May 1 to June 15	July 5
Missouri	II, III, IV, V, VI	May 5 to 30	June 30
Nebraska	I, II, III	May 15 to June 5	June 30
North Carolina	VI, VII	May 1 to 30	June 30
North Dakota	OO, O	May 15 to 30	June 20
Ohio	I, II, III	May 5 to 25	June 30
Oklahoma	V, VI	May 10 to 30	June 30
South Carolina	VI, VII, VIII	May 1 to 20	June 30
South Dakota	O, I, II	May 10 to 30	June 30
Tennessee	IV, V, VI	May 1 to 25	June 30
Virginia	IV, V, VI	May 15 to June 15	June 30
Wisconsin	OO, O, I, II	May 5 to 30	June 30

beans recently have been grown on the field.

Use inoculant prepared specifically for soybeans; inoculant containing bacteria from other legumes is not effective on soybeans. Follow the directions on the container.

In the absence of nodulation, soybeans require nitrogen fertilizer for maximum yields.

PLANTING

When To Plant

Soil temperature and day length determine the best time to plant soybeans. Growers in Northern States should plant when soil temperatures are warm enough to produce rapid germination and growth—about corn-planting time. Earlier planting increases the difficulty of obtaining good stands and controlling weeds. Full-season varieties, which take most of the growing season to mature, produce highest yields when planted at the same time as corn. Early maturing varieties should be used if planting is delayed.

Soybeans should not be planted before early May in Southern States. If planted as soon as soil temperatures are high enough to produce rapid growth, most varieties will flower too early because day length is so short. This reduces growth, yields, and quality, and increases the difficulty of controlling weeds. Full-season varieties produce well in both early and late plantings in the long growing seasons of the South.

Although soybeans may be planted with some success from early spring to early summer, the best yields come from plantings made at the proper time (table 2).

How To Plant

Width of rows.—In the Northern States, soybeans in narrow rows (18 to 28 inches) produce the highest yields. The yield advantage for narrow rows varies with variety and time of planting. Full-season varieties planted early yield almost as much in 36- to 42-inch rows as in closer rows. Farmers usually use the same planting and cultivating equipment for soybeans and other row crops; the width of row, therefore, is normally wider than 18 to 28 inches.

In the Southern States there is little advantage in rows closer than 36 to 42 inches for early plantings. The advantage of narrow rows increases in late plantings in all States.

Soybeans usually are planted with planters designed for other crops but adapted for soybeans by special plates. They are sometimes planted with a drill in which all the feed cups are covered except those needed for row planting. A row planter provides more uniform depth of seed.

If soybeans are grown on sloping land, "solid" plantings (in close rows) reduce soil erosion. Planting, cultivating, and combining on the contour reduce soil and water losses.

Rate of seeding.—Seeding rate depends on variety or size of seed, width of row, and germination of seed. The general recommendation is to plant one viable seed per inch of row. Close spacing encourages rapid growth of the soybeans and aids in weed control, but spacings closer than 1 inch may seriously increase lodging. Excessive lodging causes difficulty in combining and reduces yields.

Suggested rates of seeding are listed below. Use the lower rates for small-seeded varieties and higher rates for larger seed.

Row spacing (inches)	*Rate per acre (pounds)*
18	85 to 100
24	65 to 80
30	50 to 65
36	45 to 55
40	40 to 50

DEPTH OF SEEDING.—Shallow seeding—1 to 2 inches deep in moist soil—is recommended. If the soil is dry, it usually is better to wait for a rain than to plant too deep in an attempt to reach moist soil.

WEED CONTROL

Weed competition is a serious problem causing yield reductions in all production areas. In the South, soybean yields may be reduced as much as 50 percent from weed competition.

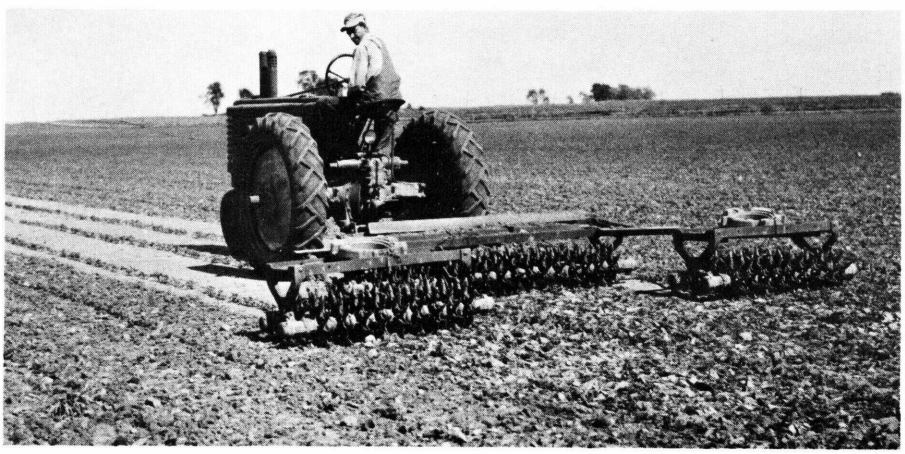
Early cultivation prevents weeds from becoming established ahead of the soybeans.

Both rowed and drilled soybeans can be cultivated effectively with a rotary hoe, drag harrow, or weeder. This equipment may be used even before the soybeans have emerged. It will destroy weeds or break a crusted layer of soil to aid emergence.

Soybean plants are easily injured by cultivating equipment just before and during emergence from the soil. After emergence there is less danger of breaking the stems if cultivation is done during the hot part of the day.

For final cultivation, row cultivating equipment is used. Cultivate, if needed to control weeds, until the beans are so large that cultivation causes damage to the plants. Cultivations should be no deeper than required to destroy the weeds.

Chemicals can be used very effectively to supplement cultural practices in controlling weeds in soybeans, and their use has increased appreciably in recent years. Chemicals are available which may be applied before planting (preplanting), at planting (preemergence), or after emergence (postemer-



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Cultivating young soybean plants with a rotary hoe.

gence). The type of weeds present and soil type influences the effectiveness of a chemical. In choosing a chemical, the grower should follow closely the current recommendations of his State agricultural experiment station or extension service.

IDA–114

Soybeans planted on the contour.

IRRIGATION

Irrigation of soybeans is not a common practice in the United States.

A good crop usually requires about 20 inches of water. In most areas where soybeans are grown, moisture is adequate, but droughts occur occasionally in all States producing soybeans, and in some areas they occur frequently.

Soybeans tolerate dry soil conditions before they bloom, but drought during the pod-filling stage seriously reduces yields and seed quality. During this stage, supplemental irrigation produces the most successful results. Irrigation of soybeans, however, usually does not increase yield as much as irrigation of corn and a number of other crops.

Contour of the land largely determines the type of irrigation. Row or flood irrigation may be used on land that has been leveled and prepared for it. On land not suited to row or flood irrigation, overhead sprinklers are used. This type of irrigation is difficult if soybeans have made heavy growth, and it requires much labor.

Heavy, infrequent irrigations usually give better results and require less labor than frequent, light irrigations. The time between irrigations depends on the type of soil and the weather.

Since heavy rains may follow irrigation in humid areas, the grower should provide for adequate drainage.

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Harvesting soybeans with a combine.

The purchase, maintenance, and operating costs of an irrigation system for soybeans should be weighed against possible returns. Soil-management practices that conserve soil moisture are frequently economical substitutes for supplemental irrigation.

Some soybeans are produced in semiarid and arid regions of the United States where irrigation supplies most or all of the water. Management problems in these areas differ from those in humid areas. Recommendations made by the experiment stations serving these areas should be followed.

HARVESTING

When To Harvest

All seeds on a soybean plant mature at essentially the same time. Maturity of the seed is accompanied by a rapid dropping of the leaves and drying of the stems. The final maturing process is so rapid that chemicals applied sufficiently early to hasten leaf-dropping result in reduced yields. Chemicals are sometimes effective in killing weeds so that combining may be done earlier and more efficiently. If the chemicals are applied before the soy-

bean leaves begin to turn yellow, yields will be reduced.

Adjusting the Combine

The instruction manual supplied by the manufacturer will tell how to adjust the combine. Check the adjustments occasionally. Look, especially, at the main points of loss—cutterbar, reel, cylinder, rack, and sieve. Moisture content of the seed may change during the day, and the combine should be adjusted to reduce splits and damage.

Harvesting loss can cut profits; losses of 10 to 20 percent of the crop do occur during combining. An average of 4 beans per square foot left in the field equals a bushel per acre.

Combining seed for planting requires special care to prevent mechanical injury. As seed moisture content drops below 12 percent, germination damage because of mechanical injury increases. When moisture content drops to or below 10 percent, cracking of the seed coat and embryo injury are more likely. Best combine cylinder speed is one that threshes properly but does not crack seed.

Yields

Soybean yields in the United States, 1960–64, averaged 24 bushels an acre. High-yielding varieties, adapted to the locality and grown under proper culture and favorable conditions, will yield more than twice the average yield. Some farmers have produced yields of more than 90 bushels an acre.

STORAGE

Soybeans require clean, dry bins. The most important function of good storage is to control moisture content.

The farmer should make sure the moisture content of every load going into a bin is no higher than 11 percent if the storage period will be about 1 year, and no higher than 10 percent if the storage period will be around 5 years.

Excessive moisture may cause molding, heating, and spoiling. Moisture tends to accumulate in the surface layer of beans near the center of the bin in cold weather. Stirring the surface beans during late fall and winter helps to break up high-moisture areas and prevent spoilage.

If they are kept dry, beans will not deteriorate appreciably in quality for a year or more. Viability deteriorates rapidly if seed is stored beyond the first planting season following harvest.

SOYBEANS FOR HAY

Soybeans make a versatile emergency hay crop because they are adapted to a wide range of planting dates. They should supplement and not substitute for alfalfa, clover, or other hay crops.

Feed Value

Good soybean hay equals other high-quality legume hay in feed value. It is difficult to cure, however, and loss of leaves or spoilage during curing may reduce quality.

Forage Varieties

There are a number of "hay type" or "forage" soybean varieties adapted to different areas of the United States. They usually have fine stems and small, dark-colored seed.

Many farmers who grow soybeans for hay prefer the forage varieties. Tests show that varieties usually used for bean production,

when drilled at the rate of 2 to 3 bushels an acre, can equal forage varieties in quantity and quality of hay production. Yields of 2 tons of soybean hay per acre are common.

Time To Cut

Recommendations on the time to cut soybean hay range from the time the pods begin to form to the time when the seeds reach full size. If the crop is cut too early, yields will be reduced. If cut too late, stems will be hard and woody and many leaves will be lost. These factors lower the feeding value of the hay.

A widely used guide in harvesting soybean hay is to cut during the first favorable weather after the seeds are half developed.

Curing

A common method of curing soybean hay is to leave it in the swath for 1 or 2 days, then rake it into small windrows. Unless drying conditions are good, the windrows may need turning once or twice before the hay is ready to bale. A "roller-crusher" attachment on the mower will hasten the curing process because crushed stems lose moisture more rapidly than whole stems.

INSECTS AND DISEASES

Corn earworms, Mexican bean beetles, bean leaf beetles, velvetbean caterpillars, lesser cornstalk borers, stink bugs, and other insects attack soybeans. If uncontrolled, some of these can destroy the crop. Occurrence, prevalence, and rate of reproduction of soybean insects vary greatly from one part of the country to another.

Damage can occur from planting time, when seed may be destroyed by the seed-corn maggot, to the maturity period, when maturing beans may be eaten by the corn earworm or damaged by stink bugs.

All insects that attack soybean plants can be controlled by timely dusting or spraying with the proper insecticide. Dust and spray programs to control insects that damage soybeans have been developed by State experiment stations.

Farmers who find insects should follow local recommendations for controlling them. Growers in Southern States, especially, should observe their fields frequently for insect damage.

Sprays or dusts that contain arsenate can damage soybeans severely. Farmers applying such sprays to crops in the vicinity of soybeans should guard against drift.

Disease-resistant varieties of soybeans have been developed and are available for production in most production areas. The use of disease-resistant varieties is the most effective means of reducing losses from diseases which may attack soybeans. Varieties are also available which resist the development of root-knot and cyst nematodes.

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